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HIGH PERFORMANCE MICROGYROS FOR SPACE APPLICATIONS

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ABSTRACT

Future space exploration missions require high performance inertial measurement systems for navigation, guidance, and attitude control. Micromachined vibratory gyroscopes are promising candidates to replace conventional gyroscopes for future miniature spacecraft control and avionics applications while simultaneously satisfying stringent physical requirements of low mass, power, volume, and cost.

This paper reports on recent experimental results of a silicon bulk micromachined vibratory microgyroscope designed for high performance space applications. This silicon vibratory microgyroscope design consists of a four leaf clover silicon structure with a central vertical post suspended by four thin silicon cantilevers (Figure 1). Previously, we demonstrated ~~that~~ this microgyroscope to have performance of 29 deg/hr bias stability and ~1.5 deg/√hr angle random walk using external rack electronics.

Significant improvements have been made on several aspects of this cloverleaf micro-gyroscope. The improved microgyroscopes tested have resonant frequencies of 3000Hz with typical Q-factor of >10000, and have demonstrated a bias stability of < 9 deg/hr, and best to date angle random walk of < 0.1 deg/√hr using open-loop electronics with no temperature compensation (Figure 2). Data on the modeling, bias stability drift, scale factor stability, temperature stability, vibration and radiation survivability of this microgyroscope will also be presented.

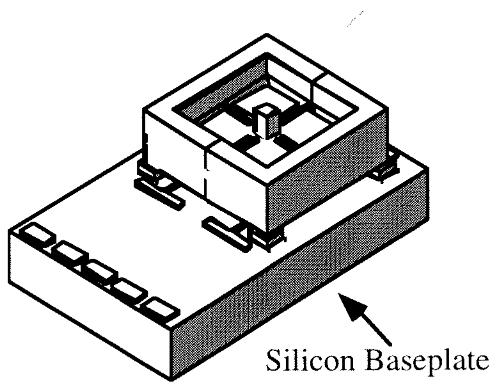

Figure 1. Schematic drawing of all-silicon cloverleaf microgyroscope.

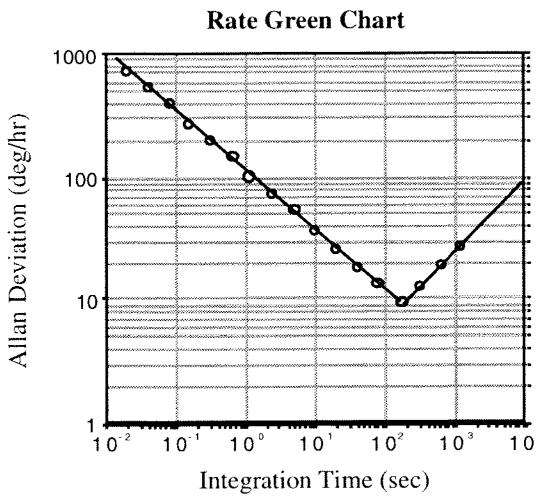

Figure 2. Green chart of the clover-leaf gyroscope.